Emulsion / SFT Alignment

Introduction

The calibration between the electronic spectrometer and the emulsion is important for the location of events and is very important for the subsequent decay search. In particular the angular alignment between the emulsion and the SFT may require some fine-tuning since the emulsion coordinate system is referenced to the spectrometer by the module frame in the SFT / Emulsion mount. After processing, this reference is compromised by distortions and non-uniformity in coatings from plate-to-plate. This note documents a careful study of the relative alignment in the angles, u' and v', for two samples.

Procedure

The information that is to extracted is the difference in angle between a track reconstructed in the SFT and in the emulsion data. Each SFT track that is within ±25 mrad of an emulsion track (or the closest within ±25 mrad if more than one exists) is used in this samples described below if:

1) the event appears to be unambiguously located (i.e. matched)
2) the SFT track is isolated from other tracks by at least 2 mm (4 fibers)
3) the SFT track has at least 3 hits per u or v view

The angular difference, $dx_i = x_{SFT} - x_{emul}$, is computed for each track for both views and is tagged as to whether the track has a measured momentum > 3 GeV/c.

Data Sets

There are two independent data sets in this analysis. The first is a set of located events all common to one quadrant of one module: (u<0, v<0) for E/B3. There may be some difference in the emulsion data depending on the quadrant since only one quarter of each sheet can be scanned without changing the position. In addition, the emulsion data is reconstructed by the most recent version of the code (`ecfscal v23`). Recall that with this version of the code, all tracks have been referenced to a single sheet, the SS sheet, i.e. sheet #1. Therefore, little variation is expected for all events in the quadrant of a given module. A total of 7 events were used with a total of 23 tracks matched. The next sample is composed of muon tracks (only) from the set of all located muon events, less one event already in the first sample. No regard for module, quadrant or `ecv` file version is made. A total 39 tracks were used for this second sample.

Results

The data for Sample 1, same module and quadrant, are shown in Figure 1. Only 11 of 23 tracks were found to have a momentum greater than 3 GeV/c. Also, 8 tracks have angles greater than 0.150 rad. Since the track angle is correlated to the momentum (negatively) the small-angle, momentum-measured tracks should be emphasized in this data. In Fig. 1, three different weighting schemes are applied to the data. The two projections are shown in Figures 2 and 3.

Sample 2 distributions, from muons, are shown in Figure 4. The results shown in the plots are summarized in Table 1. The error in the mean for Sample 1 is ±0.9 and for Sample 2 is ±0.7 . The two sets are consistent and imply that any angular offsets are small, both for a sample that is ex-

pected to be same for all tracks, and for the sample that has no restrictions. Of course, the muons are all guaranteed to be high momentum and free from hadronic scatters. The data indicates that :

a) the corrections for the chosen module and quadrant are negligible
b) the spread in angular offsets in the “global” muon sample is small
c) the two sample are consistent with each other
d) the value of s for measurement errors only is about 4.5 mrad

When more data from v23 of the emulsion reconstruction is available, data from all modules will be examined and determined if any corrections need to be applied. It appears that these residual corrections must be small for *most* of the data.

	Weight	δx' (mrad)		δy' (mrad)	
		μ	σ	μ	σ
Sample 1	w=1	-1.3	4.6	+1.5	6.2
	w=1 p<3 w=2 p>3	-1.5	4.2	+1.5	5.8
	w=1 p<3 w=4 p>3	-1.7	3.9	+1.6	5.5
	1/(θ+0.03)	-1.7	3.2	+1.0	4.4
Sample 2	w=1	-1.0	4.8	+1.1	4.4

Table 1. A summary of the results of matching the SF tracks to emulsion tracks. Sample 1 is a set of 23 tracks all from the same quadrant of E/B3. Sample 2 is a set of 38“clean” muon tracks but with no restrictions on module or quadrant.

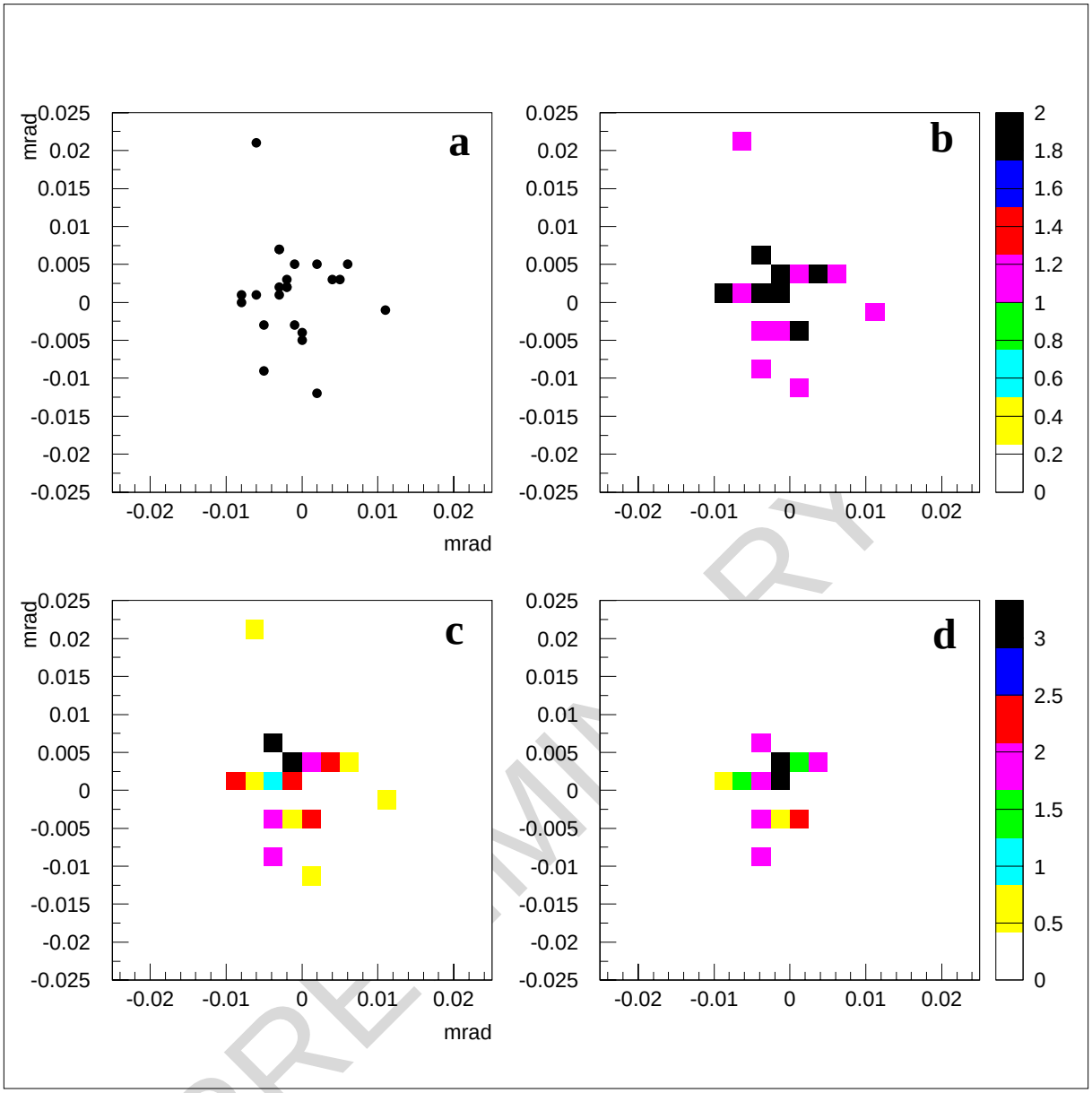

Figure 1. The distribution of δy' vs δx' for data in the same quadrant with different weighting.
(a) All data, unweighted
(b) Weight for each point in (a) is 2 if p > 3 GeV/c, 1 otherwise
(c) Weight for each point in (a) is 4 if p > 3 GeV/c, 1 otherwise
(d) Weight is 1/(θ + 0.03)

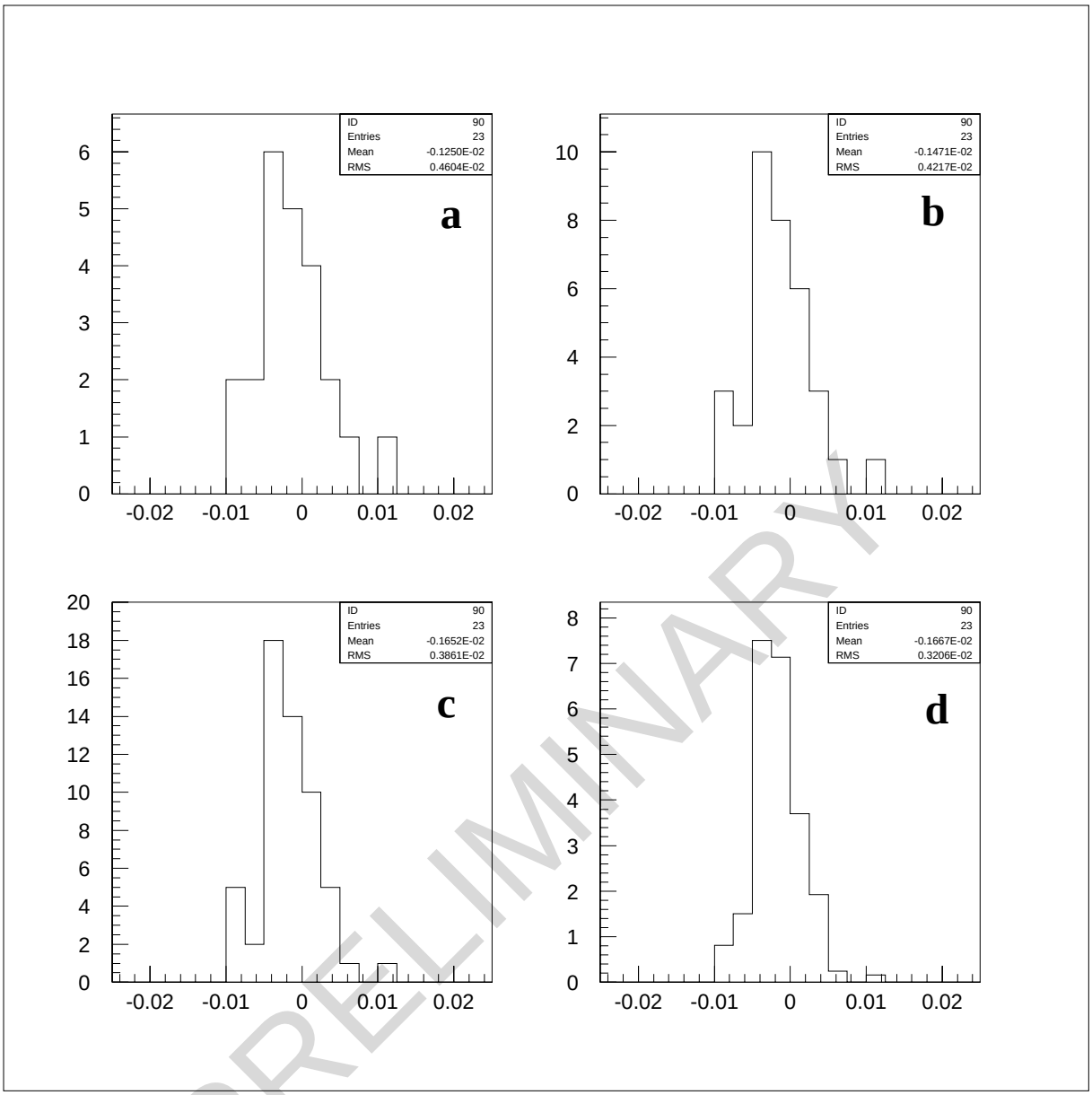

Figure 2. The δx' projections with the same sequence of weights as in Figure 1.

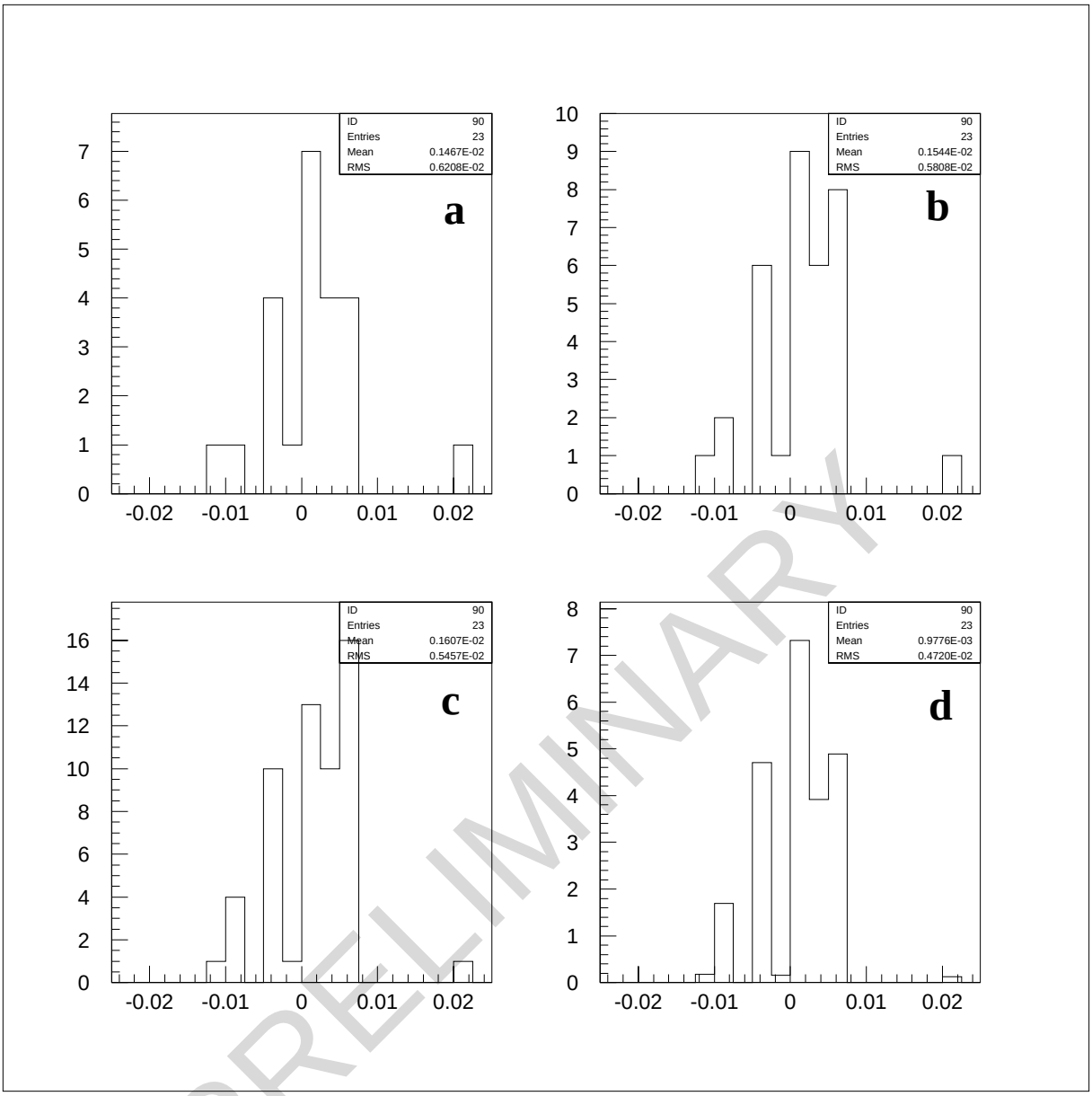

Figure 3. The δy' projections with the same sequence of weights as in Figure 1.

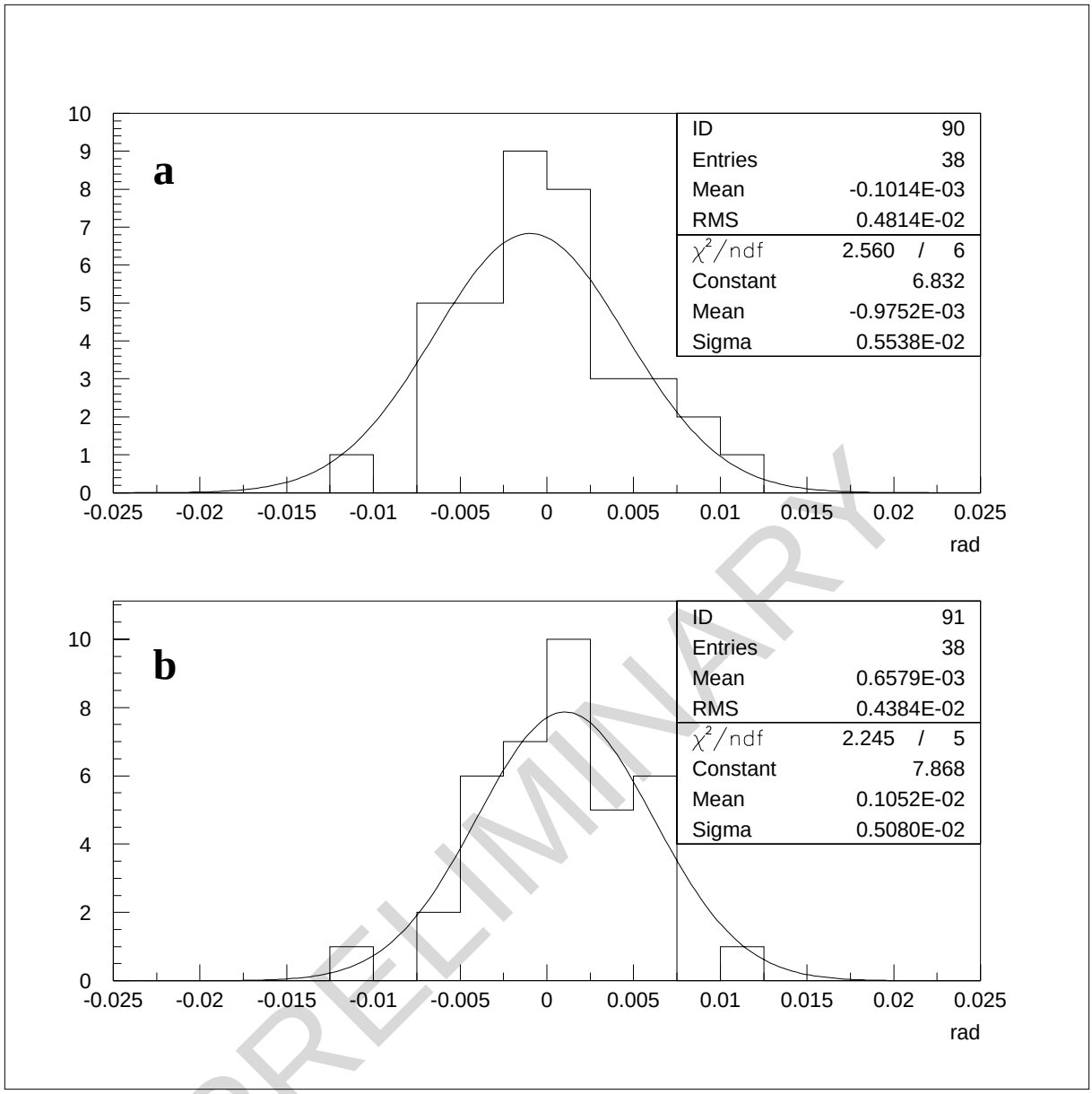

Figure 4. The (a) δx' and (b) δy' distributions for the muon tracks.

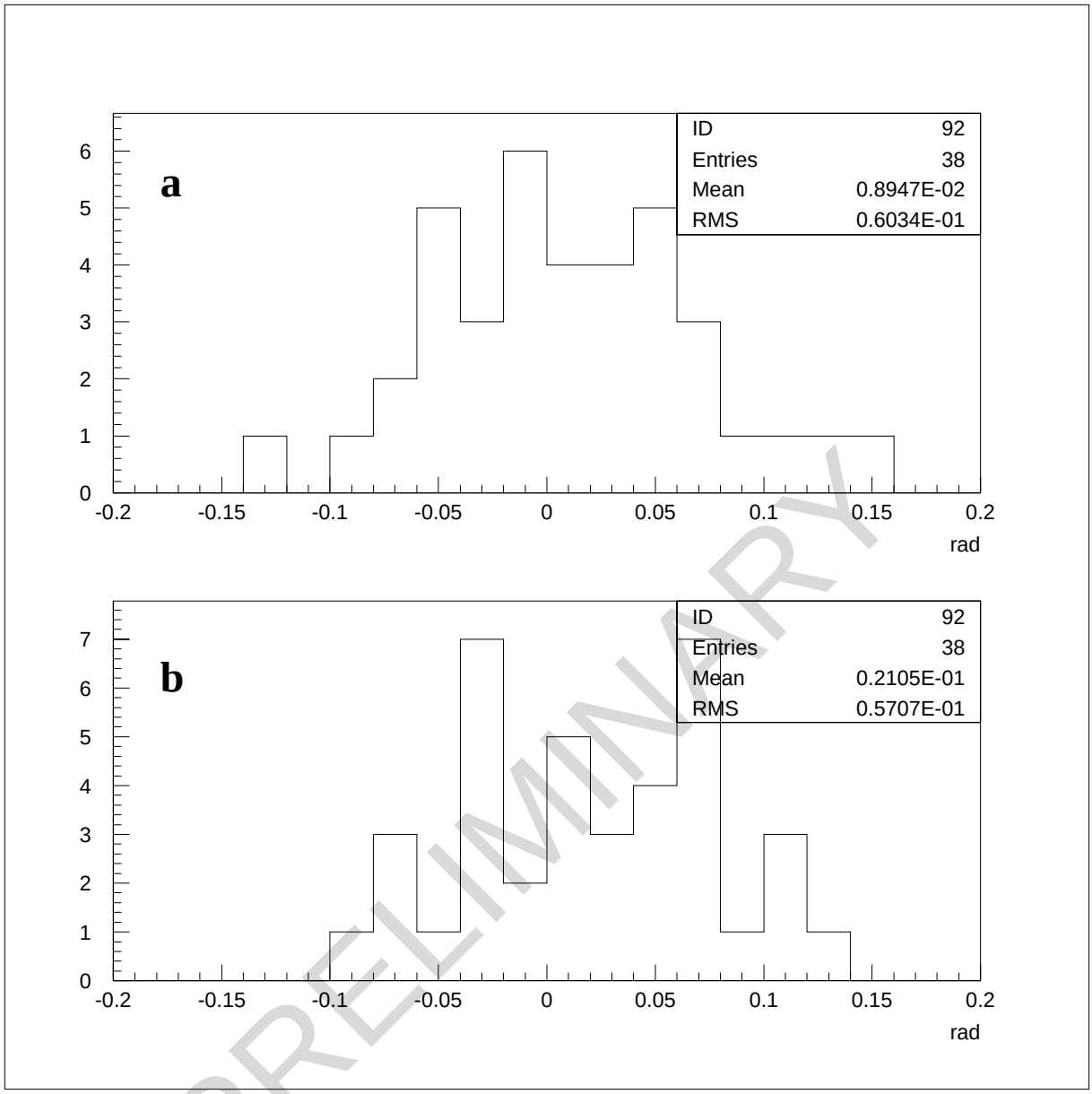

Figure 5. The distribution of the muon track angles, (a) x' and (b) y' for the data used in Fig. 4.